

OCCURRENCE OF A LATENT POLYPHENISM IN *PIERIS VIRGINIENSIS* (LEPIDOPTERA: PIERIDAE)¹

Arthur M. Shapiro^{2 3}

"Seasonal polymorphisms" are well-known in insects of several orders. They are better called polyphenisms to emphasize the lack of genetic differences among the "morphs" (phenotypes), which are produced by developmental switch mechanisms under environmental control. The control mechanisms for the seasonal polyphenisms of two Nearctic *Pieris*, *P. protodice* Boisduval and LeConte and *P. napi oleracea* Harris, have recently been shown to be photoperiodic (Shapiro, 1968; Oliver, 1970). (These belong to different species-groups or subgenera.) This is known to be true also for two Palaearctic stocks of the *P. napi* group, *P. n. napi* from England and *P. "adalwinda"* from northern Scotland and Orkney (Shapiro, unpublished data). This paper reports a hitherto unsuspected polyphenism in another member of the *napi* group, *P. virginiensis* Edwards.

Throughout its range, *P. virginiensis* is believed to be strictly univoltine although the partly sympatric, closely related *P. n. oleracea* is trivoltine in the overlap zone. Forbes (1960) mentions a "rare second brood" of *P. virginiensis* at the southern end of its range, but no specimen data are cited. The normal phenotype of *P. virginiensis* is similar to the vernal phenotype of *P. n. oleracea*, but has the vein-lines less intensely dark and contrasting. In long series some variation in the intensity of the pattern is evident, but at least traces are always present.

¹Accepted for publication: November 29, 1970 [3.0083].

²Division of Science and Engineering, Richmond College, 130 Stuyvesant Place, Staten Island, NY 10301.

³Thanks are due Mr. George Patterson of Wellsboro, Pa. for providing access to a population of *P. virginiensis*, and to Mrs. Adrienne R. Shapiro and Mr. Frank Slansky for their help in the field.

Diapause in *Pieris* spp. is also under photoperiodic control, and previous experiments have shown that early-to midsummer photoperiods, which inhibit diapause in multivoltine species such as *P. n. oleracea*, *P. protodice*, *P. brassicae* Linnaeus, and *P. rapae* Linnaeus, induce diapause in *P. virginiensis*. In *P. protodice* high temperatures inhibit diapause even under inducing photoperiods, and it is possible to separate the photoperiodic control of diapause and pattern. This has been impossible in the *napi* group, although it has not been directly established whether the two effects are physiologically linked.

On 10 May 1970 four females of *P. virginiensis* were collected in Tioga County, Pennsylvania and induced to oviposit the next day. The larvae were reared on several photoperiod and temperature regimes as well as on hosts other than the normal one, *Dentaria diphylla* Michx. (Cruciferae). One batch of seven larvae was reared under continuous illumination from a 60-watt incandescent bulb at 80°F on an abnormal host, *Sisymbrium officinale* var. *leiocarpum* DC (Cruciferae). The only one of these conditions not previously tested with this species was continuous light. The larvae grew slightly faster than the normal rate, pupating 25-27 May. Three eclosed without diapause: a male on 4 June and females on 3 and 5 June. These individuals have no trace of the dark vein-lines beneath (figure 1) and are completely indistinguishable by color and pattern from the full summer phenotype of *P. n. oleracea*. Their diapausing siblings eclosed after three to six months as normally pigmented *P. virginiensis*.

Pieris virginiensis is apparently a highly specialized derivative of

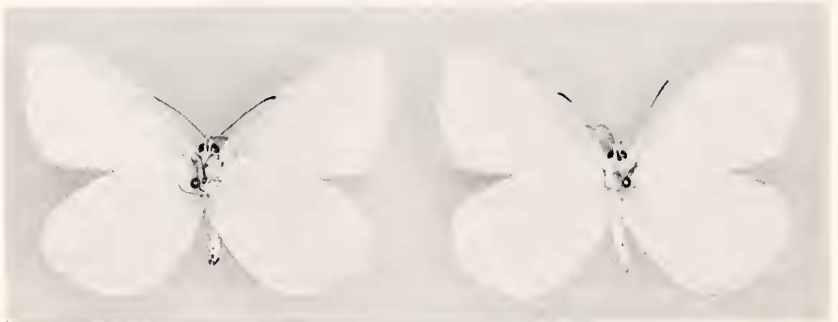


FIGURE 1. *Pieris virginiensis* bred without diapause. Male at left, female at right; ventral surfaces.

the *napi* group, with a biology completely tied to the phenology of an ephemeral, vernal host plant, dentaria. It will oviposit and can be reared in captivity on as great a variety of Cruciferae as other, less specialized *Pieris* spp. and any chemical basis for its apparent restriction to dentaria in the field is unknown. (The preference could conceivably depend on habitat selection rather than chemical cues; dentaria is often the only Crucifer in the preferred *P. virginiensis* climax-hardwoods habitat.)

In any case, the April-May flight period of *P. virginiensis* allows the resulting larvae to develop during the period of rapid dentaria growth in mid-late May. The pupae enter diapause in early June and shortly thereafter the plants die back until autumn. The adoption of an essentially obligate diapause was, then, a critical step to synchronize development with this host. Selection experiments suggest that genetic manipulation of diapause is relatively easy in multivoltine *Pieris* spp. (Shapiro, unpublished data). Assuming a direct physiological link between diapause and phenotype in the *napi* group, adoption of the *P. virginiensis* diapause system would submerge the phenotypic switch while leaving the mechanism intact. This is apparently the history of *P. virginiensis*.

Except for the assumed stability of the climax forest habitat, it is difficult to see what advantages accrued to *P. virginiensis* when it abandoned multivoltinism and general Crucifer-feeding, both of which favor a high reproductive potential, for univoltinism and monophagy. Populations of *P. virginiensis* are presently declining through much of its range, even in areas where the forest has been little disturbed. This decline began long after the introduction of *P. rapae*, and does not seem to be due to direct competition from that species. It may, however, reflect increased mortality due to the predators, parasites, or pathogens of *P. rapae*—an added burden which the low reproductive potential of *P. virginiensis* would be unable to absorb.

LITERATURE CITED

- FORBES, W. T. M. 1960. The Lepidoptera of New York and Neighboring States. Part IV. Cornell Univ. Agr. Expt. Sta., Mem. 371, 188 pp.
- OLIVER, C. G. 1970. The environmental regulation of seasonal dimorphism in *Pieris napi oleracea* (Pieridae). J. Lepid. Soc. 24: 77-81.
- SHAPIRO, A. M. 1968. Photoperiodic induction of vernal phenotype in *Pieris protodice* Boisduval and LeConte (Lepidoptera: Pieridae). Wasmann J. Biol. 26: 137-149.

2.0083. Occurrence of a latent polyphenism in *Pieris virginiensis* (Lepidoptera: Pieridae).

ABSTRACT.—*Pieris virginiensis* retains the phenotypic switch mechanism of its multivoltine relatives although it is univoltine and one phenotype is never expressed in Nature. Univoltinism is correlated with specialization to an ephemeral host plant.—ARTHUR M. SHAPIRO, *Division of Science and Engineering, Richmond College, 130 Stuyvesant Place, Staten Island, NY 10301.*

DESCRIPTORS: *Pieris virginiensis*; photoperiodism; diapause; polyphenism; niche; specialization; phenology.